Telephone survey to investigate relationships between onychectomy or onychectomy technique and house soiling in cats

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OBJECTIVE
To determine whether associations existed between onychectomy or onychectomy technique and house soiling in cats.

DESIGN
Cross-sectional study.

SAMPLE
281 owners of 455 cats in Polk County, Iowa, identified via a list of randomly selected residential phone numbers of cat owners in that region.

PROCEDURES
A telephone survey was conducted to collect information from cat owners on factors hypothesized a priori to be associated with house soiling, including cat sex, reproductive status, medical history, and onychectomy history. When cats that had undergone onychectomy were identified, data were collected regarding the cat’s age at the time of the procedure and whether a carbon dioxide laser (CDL) had been used. Information on history of house soiling behavior (urinating or defecating outside the litter box) was also collected.

RESULTS
Onychectomy technique was identified as a risk factor for house soiling. Cats for which a non-CDL technique was used had a higher risk of house soiling than cats for which the CDL technique was used. Cats that had undergone onychectomy and that lived in a multicat (3 to 5 cats) household were more than 3 times as likely to have house soiled as were single-housed cats with intact claws.

CONCLUSIONS AND CLINICAL RELEVANCE
Results of this cross-sectional study suggested that use of the CDL technique for onychectomy could decrease the risk of house soiling by cats relative to the risk associated with other techniques. This and other findings can be used to inform the decisions of owners and veterinarians when considering elective onychectomy for cats. (J Am Vet Med Assoc 2016;249:638–643)

House soiling by pet cats is a substantial and multifactorial problem, with adverse effects on the human-animal bond.1,2 The problem is defined as defecating, urinating, or spraying urine outside of the litter box.1 Many cats with house-soiling behaviors are relinquished to animal shelters by their owners, where they are at risk of euthanasia.2–4 Therefore, a decrease in the prevalence of these behaviors could lead to a decrease in the prevalence of relinquishment of cats to animal shelters and their subsequent euthanasia.1,5

Several factors have been identified to contribute to house soiling by cats, including concurrent medical conditions, social hierarchy of cats within the home, neuter status, availability of adequately sized and spaced litter boxes, and type and cleanliness of cat litter or litter box.6–8 Concurrent medical conditions that can provoke house-soiling behavior include diseases of the urinary tract, gastrointestinal tract, endocrine system, and musculoskeletal system.6,9,10 Behavioral factors associated with house soiling include, but are not limited to, anxiety and distress from intercat aggression within the household, presence of neighborhood cats, and disruption of typical routine.6–8 Cats in multicat households are more likely to house soil than cats in single-cat households.2,6,11 Sexually intact male cats are more likely to urine mark than neutered male cats.6,9,11

The percentage of owned cats in the United States that have undergone onychectomy (removal of the third phalanx of each digit) has been estimated as approximately 24.4%, representing an increase of 4.4% since 2001.12,13 Much debate exists regarding appropriate reasons for this procedure in cats.5,13,14 Owners may elect to have their cat undergo onychec-
tomy for various reasons, including minimization of destructive behaviors directed toward property, scratching injury toward members of the family, and risk of injury to immunosuppressed people and removal of diseased nails.\(^{5,12-14}\)

Proponents of onychectomy claim that, for the previously stated reasons, many cats would otherwise be euthanized or relinquished.\(^{12,14-17}\) They also purport that onychectomy typically results in minimal postoperative complications for cats.\(^{17,18}\) Adversaries of onychectomy contend that the procedure has many adverse effects in cats, including subsequent medical and behavioral problems, inability of the cat to defend itself, and reduced ability to engage in natural behaviors.\(^{12-14,19,20}\) They also argue that there are many alternatives to onychectomy, such as behavioral and environmental modification to reduce scratching behaviors, training of owners to provide low-stress nail trims, application of plastic nail caps to cats, and education of veterinarians and veterinary staff about feline-friendly handling techniques designed to reduce distress and risk of injury at the veterinary clinic\(^{5,14,16,17,20-22}\).

Several methods of onychectomy are used, including the scalpel, so-called guillotine, and CDL techniques.\(^{13,19,22}\) Historically, veterinarians have used the scalpel or guillotine technique in conjunction with tourniquets to perform onychectomy, and these techniques are associated with various complications.\(^{12,13,19}\) More recently, the CDL technique has become the preferred approach because of its briefer healing period, which is attributable to lower amounts of hemorrhage and ischemic tissue production than with other techniques.\(^{19,23,24}\) The CDL procedure also results in less lameness than with other onychectomy techniques.\(^{19,23}\)

Both short- and long-term complications have been associated with onychectomy.\(^{12,13,18,19,23}\) Temporary problems include lameness, pain and discomfort, constipation, and litter box aversion.\(^{12,23}\) Cats undergoing scalpel onychectomy are also more reluctant to walk after surgery than are dogs following cranial cruciate surgery.\(^{24}\) Less common but more severe complications that can develop include chronic pain, muscle loss, bone spurs, and claw regrowth.\(^{12,20-28}\)

Onychectomy purportedly leads to house soiling by cats because of the distress associated with the procedure as well as subsequent litter box substrate aversion.\(^{12,29}\) Owners report that house soiling by their cats began only after onychectomy.\(^{14,29,30}\) Additionally, onychectomy is a potentially painful procedure,\(^{24,25}\) and studies\(^{2,6,7}\) have shown that cats that have pain when posturing to urinate are more likely to urinate outside of the litter box.

To the authors’ knowledge, no studies have been conducted to evaluate whether the onychectomy technique has an influence on the prevalence of house soiling. The purpose of the study reported here was to investigate whether onychectomy or the technique used would be associated with house soiling by pet cats in the United States. We also sought to determine whether age of the cat at the time of onychectomy would be associated with house soiling.

## Materials and Methods

### Sample

Participants for a telephone survey were identified by use of a list of randomly selected residential phone numbers and addresses of cat owners in Polk County, Iowa, that had been purchased from a market research company\(^a\) in conjunction with the Iowa State University Survey and Behavioral Research Services. Potential participants were initially mailed a postcard several weeks before the study began, describing the study and requesting their participation in a brief telephone survey in the upcoming weeks. Households were then contacted via telephone and asked to participate during June and July 2011. The study protocol was approved by the Iowa State University Institutional Review Board.

### Survey

A survey was developed by the authors to collect information from owners on factors hypothesized to be associated with house soiling, including cat sex, reproductive status, prior or existing medical conditions, and whether onychectomy had been performed (Supplemental Appendix S1, available at http://avmajournals.avma.org/doi/suppl/10.2460/javma.249.6.638). For cats for which onychectomy had been performed, questions were included as to whether that procedure involved CDL and the cat’s age at the time of onychectomy. Information on history of house soiling (urinating or defecating outside the litter box) was also collected, including age when the behavior began, frequency of the behavior, whether veterinary attention was sought to address the house soiling, and whether the behavior had since resolved. The name of the veterinary clinic where onychectomy was performed was also requested. The survey was pretested on cat-owning members of the phone bank team from the Iowa State University Survey and Behavioral Research Services.

After pretesting concluded, interviewers from the Iowa State University Survey and Behavioral Research Services telephoned the listed cat-owning households and asked to speak to any adult in the household who could attest to the signalment, onychectomy status, behavior, and medical history of each cat within the home. Participating adults are subsequently referred to as cat owners. Following each interview, personnel at any veterinary clinic mentioned in the survey were contacted to verify that onychectomy had been performed during the time specified and confirm whether the procedure involved the CDL technique.

### Statistical analysis

Statistical software\(^b\) was used to perform Fisher exact tests to determine whether the prevalence of house soiling behavior differed between before and after onychectomy or between onychectomy techniques (CDL vs other). The Fisher exact test was also used to determine whether age of the cat at the time of onychectomy was associated with subsequent house soiling, stratified by onychectomy technique; whether the number of cats per household was associated with house soiling, stratified by onychectomy status; and whether sex and reproductive status were associated with house soiling, stratified by onychectomy status.
A linear regression model was fit to analyze age at onset of house soiling, with age at onychectomy as a predictor variable, categorized as < 6 months, 6 to 12 months, 1 to 2 years, and 2 to 5 years. Different statistical software was used to fit a multivariate general linear model to predict house soiling on the basis of current age, number of cats per household, onychectomy status, and onychectomy technique. Risk ratios and 95% CIs were calculated for each predictor variable and any significant interactions among them. Additionally, a generalized linear mixed model was fit to test for random effects attributable to clustering within households that would influence the results. Values of $P < 0.05$ were considered significant.

**Results**

**Respondents and cats**

Initial telephone screening of 2,487 households on the provided list resulted in identification of 299 (12.0%) households eligible for the study. Of these eligible households, 15 (5.0%) representatives declined to participate, and contact could not be established for 3 (1.0%) households. Consequently, 281 interviews were completed, involving 455 cats. Most respondents had 1 ($n = 148$; 52.7%) or 2 ($n = 102$; 36.3%) cats in the household.

Of the 455 cats, 12 (2.6%) were < 1 year of age, 154 (33.8%) were between 1 and 4 years of age, 148 (32.5%) were between 5 and 9 years of age, 107 (23.5%) were between 10 and 14 years of age, and 32 (7.0%) were between 15 and 20 years of age. The age of 2 (0.4%) cats was unknown.

Sex was evenly distributed, with 225 (49.5%) male cats and 229 (50.3%) female cats. Sex of 1 (0.2%) cat was unknown. Nearly all (430 [94.5%]) of the cats were reported as spayed or neutered. Only 21 (4.6%) cats were sexually intact, and the reproductive status of 4 (0.9%) cats was unknown. Overall, 172 (37.8%) cats had a history of house soiling.

**Table I**—Results of Fisher exact tests of factors hypothesized to be associated with a history of house-soiling behavior in 455 pet cats of 281 owners in Polk County, Iowa, who participated in a telephone survey.

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. (%) with house-soiling behavior</th>
<th>No. (%) without house-soiling behavior</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Onychectomy status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Claws intact</td>
<td>33 (21.9)</td>
<td>118 (78.1)</td>
<td>0.14</td>
</tr>
<tr>
<td>Claws removed</td>
<td>87 (28.6)</td>
<td>217 (71.4)</td>
<td></td>
</tr>
<tr>
<td><strong>Onychectomy technique</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDL</td>
<td>5 (13.9)</td>
<td>31 (86.1)</td>
<td>0.007</td>
</tr>
<tr>
<td>Other</td>
<td>40 (39.6)</td>
<td>61 (60.4)</td>
<td></td>
</tr>
<tr>
<td><strong>Age at onychectomy</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\geq$ 6 mo</td>
<td>21 (28.8)</td>
<td>52 (71.2)</td>
<td>0.27</td>
</tr>
<tr>
<td>$&lt; 6$ mo</td>
<td>24 (38.7)</td>
<td>38 (61.3)</td>
<td></td>
</tr>
<tr>
<td><strong>Age at onychectomy, by technique used</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\geq$ 6 mo</td>
<td>3 (15.8)</td>
<td>16 (84.2)</td>
<td>1.0</td>
</tr>
<tr>
<td>$&lt; 6$ mo</td>
<td>2 (11.8)</td>
<td>15 (88.2)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\geq$ 6 mo</td>
<td>18 (33.3)</td>
<td>36 (66.7)</td>
<td>0.15</td>
</tr>
<tr>
<td>$&lt; 6$ mo</td>
<td>22 (48.9)</td>
<td>23 (51.1)</td>
<td></td>
</tr>
<tr>
<td><strong>No. of cats in household, by onychectomy status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Claws removed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>13 (34.2)</td>
<td>25 (65.8)</td>
<td>0.84</td>
</tr>
<tr>
<td>$\geq$ 2</td>
<td>32 (32.3)</td>
<td>67 (67.7)</td>
<td></td>
</tr>
<tr>
<td>Claws intact</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>14 (35.0)</td>
<td>26 (65.0)</td>
<td>0.03</td>
</tr>
<tr>
<td>$\geq$ 2</td>
<td>19 (17.1)</td>
<td>92 (82.9)</td>
<td></td>
</tr>
<tr>
<td><strong>Sex, by onychectomy status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Claws removed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>40 (25.8)</td>
<td>115 (74.2)</td>
<td>0.31</td>
</tr>
<tr>
<td>Male</td>
<td>47 (31.5)</td>
<td>102 (68.5)</td>
<td></td>
</tr>
<tr>
<td>Claws intact</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>21 (28.4)</td>
<td>53 (71.6)</td>
<td>0.08</td>
</tr>
<tr>
<td>Male</td>
<td>12 (15.8)</td>
<td>64 (84.2)</td>
<td></td>
</tr>
</tbody>
</table>

— = Not applicable.

Values of $P < 0.05$ were considered significant.
cats had needed treatment at some point in their lives for any medical condition, with 43 (25.0%) of these cats requiring medical attention because of house soiling in the home.

Onychectomy

Three hundred four (66.8%) cats had undergone onychectomy. Most cats (n = 298 [98.0%]) that had undergone onychectomy were also spayed or neutered. Of the 21 sexually intact cats, only 4 (19.0%) had undergone onychectomy. Most cats (n = 246 [80.9%]) had undergone onychectomy at < 1 year of age, and 121 (39.8%) had been ≤ 6 months of age. Of the cats that had undergone onychectomy while cared for by their current owner (n = 243), only 36 (14.8%) had undergone the CDL technique specifically. However, the technique used for onychectomy was unknown for 106 (43.6%) of the cats that had undergone the procedure while cared for by their current owner.

House soiling

Twenty-six percent of all cats in the study were reported by owners to have urinated or defecated outside the litter box at some point in their lives. Of these, 70 (58.3%) were < 9 years of age, with 13 (10.8%) < 1 year of age, when the behavior occurred or began. Also, of the cats that had house soiled, 42 (35.0%) did so once or twice a month and 22 (18.3%) did so once or twice a year. Only 38 of the 120 (31.7%) cats with house soiling behavior were evaluated by a veterinarian for this condition. For 68 (56.7%) cats, owners reported that the behavior resolved, compared with 52 (43.3%) for which house soiling persisted.

Associations with house soiling

Eighty-seven (28.6%) cats that had undergone onychectomy were reported to have house soiled, compared with 33 (21.9%) cats with intact claws. This difference was not significant (P = 0.14; Table 1). For cats that had undergone onychectomy, the proportion that had house soiled was significantly (P = 0.007) lower among cats for which a CDL technique versus another technique was used.

No significant (P = 0.27) association was identified between age at onychectomy and house soiling. When age at onychectomy was stratified by onychectomy technique, a greater proportion of cats for which a non-CDL technique was used prior to 6 months house soiled, compared with the proportion that did for which a non-CDL technique was used after 6 months of age; however, the difference was not significant (P = 0.15; Table 1). Cats for which the CDL technique was used prior to 6 months of age had no significantly (P = 1.0) greater likelihood of house soiling than did cats for which this technique was used after 6 months of age. Use of linear regression to identify any association between age at onychectomy and age at onset of house soiling revealed that the slope of the comparison was not significantly (P = 0.53) different from 0 (Figure 1), indicating no association.

For cats that had had their claws removed, no significant (P = 0.84) association was identified between the number of cats per household and house soiling (Table 1). For cats with intact claws, those in single-cat households were significantly (P = 0.05) more likely to have house soiled than those in households with > 1 cat. No significant association was identified between sex and house soiling for the group of cats with intact claws or the group that had undergone onychectomy.

Use of a general linear model to predict house soiling on the basis of the cat’s current age, number of cats per household, onychectomy status, and onychectomy technique revealed that current age was the most significant predictor, followed by 3 to 5 cats/household, and then the interaction between onychectomy status and 3 to 5 cats/household. The interaction between onychectomy status and 3 to 5 cats/household had the highest overall risk ratio (3.1; 95% CI, 1.3 to 7.6), indicating that cats that had undergone onychectomy and that lived in a multicat household were more than 3 times as likely to have house soiled as were single-housed cats with intact claws. Cats that had undergone onychectomy by a non-CDL technique had a nonsignificant risk ratio of 1.5 (95% CI, 0.8 to 2.8) for house soiling. The interaction between onychectomy status and having 2 cats/household had a nonsignificant risk ratio of 1.2 (95% CI, 0.7 to 2.3).

The variables age, 3 to 5 cats/household, and onychectomy status by themselves did not alone have significant risk ratios (data not shown). Additionally, the generalized linear mixed model revealed that there was no random effect of household that would influence results (ie, the covariance parameter estimate was 0).

Figure 1—Age at time of onychectomy versus age at onset of house-soiling behavior for 74 pet cats for which complete information was provided in a telephone survey of cat-owning households in Polk County, Iowa. Solid line represents the regression line (R² = 0.006), and dotted lines represent the 95% CI of that line. The relationship between these 2 variables was not found to be significant (P = 0.53).
Discussion

Results of the study reported here supported the hypothesis that onychectomy is associated with an increase in house soiling behavior of cats. However, cats were significantly less likely to have had such behavior when the CDL technique was used instead of another onychectomy technique. The CDL technique has been shown to result in less hemorrhage, postoperative lameness and pain, and ischemic tissue production than other techniques.\(^{2,6,7,9–11}\) Healing time is also more rapid when CDL is used for onychectomy.\(^{24}\) It seems possible that, as a result of the increased pain and duration of healing associated with non-CDL techniques for onychectomy, such surgery could initially lead to temporary litter box aversion.\(^{12,29}\)

We hypothesized that temporary litter box aversion attributable to postoperative pain would result in a pattern of litter box avoidance and house soiling in the study reported here. Additionally, we speculated that chronic or neuropathic pain associated with the onychectomy procedure could affect the cat’s comfort when using a litter box. Although our findings supported these suppositions, results with regard to age at the time of onychectomy were not as expected. The data regarding the CDL technique suggested that older age at the time of onychectomy was not associated with an increased risk of house soiling. The association between age at the time of onychectomy by a non-CDL technique and the risk of house soiling was not found to be significant. A significant association between age at onychectomy and house soiling could have supported the supposition that cats undergoing onychectomy during their early development would come to associate the pain of onychectomy with use of the litter box.

Contrary to previous reports, when cats in the present study were stratified by the number of cats per household and sex, onychectomy was not associated with house soiling. Interestingly, for cats with intact claws, those that lived without other cats were more likely to have house soiled than those that lived with other cats, contrary to the findings of other studies.\(^{2,6,7,9–11}\) The reason that sex had no significant association with house soiling by cats that had undergone onychectomy remains unclear. Perhaps this lack of association was attributable to the high proportion of cats that had undergone onychectomy that were also spayed or neutered (94.5%), which may have decreased the proportion of male cats with urine spraying behavior, which owners might report as house soiling.

When age at onychectomy was examined for an association with age at onset of house soiling, no such association was identified. This was not an expected result because we believed that these 2 variables would be correlated. However, data for age at the time of onychectomy were collected in age ranges, whereas data for age at onset of house soiling were collected on a continuous scale, which could have made analysis of these data less reliable and more difficult to interpret. Because it may be difficult for owners to accurately recall the age of their cat at a specific event, this result could also have been influenced by recall bias. Additionally, because the survey was cross sectional in nature, the temporality of events could not be reliably assessed. Furthermore, not all survey responses were checked against the respective medical records, so no means existed by which the reliability of those responses could be assessed.

Interestingly, when the significant predictor variables identified in univariate analyses were fit to a multivariate general linear model, the onychectomy technique used no longer had a significant association with house soiling. However, current age, 3 to 5 cats/household, and having cats that had undergone onychectomy in a 3- to 5-cat household were all significant predictors of house soiling. Notably, having cats that had undergone onychectomy in a 3- to 5-cat household increased the risk of house soiling by more than 3-fold, indicating that the association between onychectomy and house soiling was influenced by the number of cats per household. Compare this finding with the results of the analysis in which onychectomy status was stratified by the number of cats per household, which showed that onychectomy status had no confounding effect on this association. Taken together, these results indicated that when there were 3 to 5 cats in a household that had also undergone onychectomy, there was a greater risk of house soiling in that household.

Given the cross-sectional survey design of the present study, several limitations existed. The collected data were largely subject to recall bias by the owners, and whether onychectomy preceded the start of the house soiling behavior could not be definitively established. In addition, although veterinary personnel were contacted to confirm the onychectomy techniques used in their clinics, the precise onychectomy technique used on the individual cats in the study was not independently confirmed. The small number of cats in some comparison groups also resulted in limited statistical power to detect differences between them. Furthermore, because the CDL technique was not reported in the veterinary literature until 2002,\(^{30,31}\) the possibility existed that approximately 25% of the cats in the study (\(\geq 11\) years of age) could not have had the CDL technique performed, resulting in a sampling bias. Finally, the generalizability of these findings may be weak because the percentage of cats that had undergone onychectomy in Polk County was a much higher percentage than the nationwide percentage in 2001 and 2014.\(^{12,13}\)

Despite the aforementioned limitations, the finding that a non-CDL approach to onychectomy versus a CLD approach was significantly associated with an increased risk of house soiling by cats should help owners and veterinarians make informed decisions regarding elective onychectomy. If onychectomy is deemed necessary because of pathological conditions of the nails or a threat of relinquishment or euthanasia from owners unwilling to pursue nonsurgical techniques to reduce scratching, then we recommend that the CDL technique be used.

Acknowledgments

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Footnotes

b. GraphPad Prism, version 6, GraphPad Software Inc, La Jolla, Calif.
c. SAS, version 9.2, SAS Institute, Cary, NC.
References


